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Status review of *Howellia aquatilis*, U.S.



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STATUS REVIEW OF *Howellia aquatilis*

U.S. FOREST SERVICE - REGION 1

FLATHEAD NATIONAL FOREST

MONTANA

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Prepared by:

J. Stephen Shelly, Botanist
Montana Natural Heritage Program
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I. SPECIES INFORMATION

A. CLASSIFICATION

1. SCIENTIFIC NAME: Howellia aquatilis A. Gray.
2. COMMON NAME: Water howellia.
3. FAMILY: Campanulaceae (Harebell Family).
4. GENUS: Howellia is a monotypic genus, represented by H. aquatilis. The taxon was first discovered in 1879 by Thomas and Joseph Howell, near Portland, Oregon. These original specimens were subsequently determined to be a new genus and species by Asa Gray, who described it in the scientific literature that year (Gray, 1879).

The genus which seems most closely related to Howellia is Legenere. This genus is also monotypic, consisting only of the species L. limosa, and occurs in dried beds of vernal pools in the Central Valley of California (Munz, 1959).

Within the Campanulaceae, Howellia is placed in the subfamily Lobelioideae, distinguished from the subfamily Campanuloideae in having irregular (asymmetric) corollas, as opposed to the regular (symmetric) corollas of the latter.

B. PRESENT LEGAL OR OTHER FORMAL STATUS

1. FEDERAL STATUS

- a. U.S. FISH AND WILDLIFE SERVICE: Howellia aquatilis is currently included in Category 2 of the U.S. Fish and Wildlife Service Notice of Review (Federal Register, 9/27/85), under consideration for federal listing as an endangered species. Category 2 taxa are those "...for which information now in possession of the Service indicates that proposing to list them as endangered or threatened species is possibly appropriate, but for which substantial data on biological vulnerability and threat(s) are not currently known or on file to support the immediate preparation of rules" (= federal candidate taxa).
- b. U.S. FOREST SERVICE: Howellia aquatilis is currently included on the list of proposed sensitive species for Region 1 (Northern Region) of the U.S. Forest Service (Pierce et

al., 1987 draft). Agency objectives and policy in the 1984 Forest Service Manual provide for the management and protection of sensitive species (Sections 2670.22, 2670.32). Under these guidelines, the U.S. Forest Service is to "(a)void or minimize impacts to species whose viability has been identified as a concern" (2670.32.3), and is to "(e)stablish objectives for Federal candidate species, in cooperation with the FWS...and the states" (2670.32.5).

2. STATE: Howellia aquatilis has been listed as "recommended endangered" by the Montana Rare Plant Project (Lesica et al., 1984). This category includes "(a)ny species that is in danger of extinction throughout all or a significant portion of its range in Montana."

Howellia aquatilis is currently listed by the Montana Natural Heritage Program (Shelly, 1988) as "endangered throughout range" (6 - 20 occurrences; global rank = G2). In Montana, it is listed as "critically endangered", owing to factors making it especially vulnerable to extirpation from the state (state rank = S1).

None of these federal or state ranks currently provide any direct legal protection for H. aquatilis.

C. DESCRIPTION

1. GENERAL NONTECHNICAL DESCRIPTION: Howellia aquatilis is a strictly aquatic species, which occurs as a mostly submerged plant rooted in the bottom sediments of the ponds and sloughs to which it is adapted. It is an annual, completing its entire life cycle in one growing season, and disappearing completely upon desiccation of its habitat at the end of the summer. The stems are branched several inches from the base, and each branch then extends to the surface of the water. The numerous leaves are an inch or two long, and very narrow.

Howellia aquatilis produces two types of flowers. Along the stem beneath the water surface, small flowers form which do not develop a conspicuous corolla (floral tube). In addition, as the branches reach the surface, more conspicuous flowers develop above the water. These emergent flowers are white, have five lobes on one side of the corolla, and are about $\frac{1}{4}$ inch across. Both

types of flowers give rise to thin-walled fruits which are an inch or more long, and which contain one to five or so large, shiny brown seeds which can be about $\frac{1}{4}$ inch long.

In Montana, the emergent flowers are in bloom from late June to August. The actual duration may be longer in certain cases, depending on the rate of drying of the habitat.

See Section V, pp. 113-120, for color photos of the plants and habitat.

2. TECHNICAL DESCRIPTION: Flaccid annual, aquatic herb, mostly submergent, often with emergent branches; plants naked below, branched above; whole plant glabrous, green, about 10-60 cm. (4-24 in.) tall, occasionally taller; leaves numerous, alternate, or some of them subopposite or whorled in threes, linear or linear-filiform, entire or nearly so, 1-5 cm. (0.4-2 in.) long, up to 1.5 mm. (0.06 in.) wide; flowers white, mostly 3-10, axillary, often scattered, pedicellate or subsessile, both petaliferous (when emergent) or much reduced and inconspicuous (when submerged), the fully-developed corollas about 2-2.7 mm (0.08-0.11 in.) long, irregular, with the tubes deeply cleft dorsally, and five-lobed; filaments and anthers connate, two of the anthers shorter than the others; calyx lobes 1.5-7 mm. (0.06-0.28 in.) long; stout pedicels 1-4 (8) mm. (0.04-0.16 (0.3) in.) long, merging gradually with the base of the capsule; ovary unilocular, with parietal placentation; stigma 2-lobed; fruit 5-13 mm. (0.2-0.5 in.) long, 1-2 mm. (0.04-0.08 in.) thick, irregularly dehiscent by the rupture of the very thin lateral walls; seeds large, 2-4 mm. (0.08-0.16 in.) long, 5 or fewer, shiny brown (adapted from Hitchcock et al., 1959; Dorn, 1984).
3. LOCAL FIELD CHARACTERS: Howellia aquatilis is the only member of the Campanulaceae in Montana which is strictly aquatic. Downingia laeta can occur in wet places in meadows or on the edges of ponds, but is distinguishable by its light blue or purplish flowers marked with white or yellow; it was not observed in the Swan Valley during field surveys. Heterocodon rariflorum, a species of moist areas in Lake and Ravalli Counties, has regular, blue flowers. The annual habit, distinctive habitat, and irregular white flowers of H. aquatilis thus serve to distinguish it from all other members of the family in northwestern Montana.

D. GEOGRAPHICAL DISTRIBUTION

1. RANGE: Howellia aquatilis is currently known from a total of ten sites, in Washington (Clark and Spokane Counties; J. Gamon, WA Natural Heritage Program, pers. comm.), and Montana (Swan Valley, eastern Lake and northeastern Missoula Counties). It is historically known from one collection in California (Mendocino County; Smith and York, 1984), three locations in northwestern Oregon (S. Yamamoto, OR Natural Heritage Program, pers. comm.), and two collections (one possibly misidentified) in northern Idaho (S. Caicco, ID Natural Heritage Program, pers. comm.). In Montana, it has been located on the Flathead National Forest, as well as on private lands.
2. CURRENT SITES (MONTANA): Howellia aquatilis was first discovered in Montana, near Lindbergh Lake in Missoula County, in 1978 (McCune, 1982). Since that time, it has been documented from six additional sites, all in Lake (4) and Missoula (2) Counties. The seven known locations are all in the Swan Valley, from near Lindbergh Lake to Swan Lake. At these seven sites, it is found in one to twelve or more adjacent ponds or oxbow sloughs; a total of 52 populations have been located. The legal descriptions, latitude, and longitude, elevations, USGS topographic quad names, and locations of the populations at each site are provided in Table 1; Table 1A (pp. 5-11) lists those populations which occur wholly or partially on U.S. Forest Service lands, and Table 1B (pp. 12-15) lists those sites on lands of other ownership. The distribution in Montana is indicated in Figure 1 (p.16); the exact locations are indicated on the maps provided in Section IV, pp. 94-101. Throughout this report, the three-digit occurrence numbers are indicated in parentheses after the site names, and correspond to the numbers on the computer print-outs.
3. HISTORICAL SITES (MONTANA): All populations of H. aquatilis in Montana have been recently verified (1984-1987). There are no known historical records in the state.
4. UNVERIFIED REPORTS (MONTANA): None.
5. AREAS SURVEYED BUT SPECIES NOT LOCATED: Prior to 1987, 176 ponds or other wetland habitats had been surveyed for H. aquatilis; of these, 16 support populations, and 160 apparently do not. In 1987, 172 additional wetland locations were surveyed;

TABLE 1A. *Hwellia aquatilis* locations wholly or partially occurring on U.S. Forest Service lands, Missoula and Lake Counties, Montana. Occurrences are clustered under the site name, and are then listed in numerical order.

CONDON CREEK

Occurrence number: 006

COUNTY: MISSOULA

Township & Range: 021N016W Section: 18 Subsection/additional sections: NE4NW4SW4

Latitude: 473442 Longitude: 1134217 Elevation: 3740

USGS Quad: CONDON

Location: SWAN VALLEY, WEST BASE OF SWAN RANGE UPLIFT, 3.5 AIR MILES
NORTH OF CONDON, 2.1 AIR MILES EAST OF ST. HWY. 83, 0.1 AIR
MILES SOUTH OF CONDON CREEK.

Occurrence number: 020

COUNTY: MISSOULA

Township & Range: 021N016W Section: 18 Subsection/additional sections: SW4NE4SW4

Latitude: 473433 Longitude: 1134212 Elevation: 3740

USGS Quad: CONDON

Location: SWAN VALLEY, 3.3 AIR MILES NORTH OF CONDON, 2.13 AIR MILES
EAST OF ST. HWY 83, 0.25 AIR MILES SOUTH OF CONDON CREEK.

Occurrence number: 021

COUNTY: MISSOULA

Township & Range: 021N016W Section: 18 Subsection/additional sections: SW4NE4SW4

Latitude: 473432 Longitude: 1134216 Elevation: 3740

USGS Quad: CONDON

Location: SWAN VALLEY, 3.3 AIR MILES NORTH OF CONDON, 2.08 AIR MILES
EAST OF ST. HWY 83, 0.28 AIR MILES SOUTH OF CONDON CREEK.

Occurrence number: 022

COUNTY: MISSOULA

Township & Range: 021N016W Section: 18 Subsection/additional sections: SW4NE4SW4

Latitude: 473431 Longitude: 1134207 Elevation: 3750

USGS Quad: CONDON

Location: SWAN VALLEY, 3.28 AIR MILES NORTH OF CONDON, 2.18 AIR MILES
EAST OF ST. HWY 83, 0.27 AIR MILES SOUTH OF CONDON CREEK.

Occurrence number: 023

COUNTY: MISSOULA

Township & Range: 021N016W Section: 18 Subsection/additional sections: NW4SE4SW4

Latitude: 473427 Longitude: 1134214 Elevation: 3740

USGS Quad: CONDON

Location: SWAN VALLEY, 3.2 AIR MILES NORTH OF CONDON, 2.10 AIR MILES
EAST OF ST. HWY 83, 0.35 AIR MILES SOUTH OF CONDON CREEK.

TABLE 1A. (cont.).

CONDON CREEK (cont.)

Occurrence number: 024

COUNTY: MISSOULA

Township & Range: 021N016W Section: 18 Subsection/additional sections: SW4SE4SW4

Latitude: 473422 Longitude: 1134212 Elevation: 3740

USGS Quad: CONDON

Location: SWAN VALLEY, 3.09 AIR MILES NORTH OF CONDON, 2.10 AIR MILES
EAST OF ST. HWY 83, 0.47 AIR MILES SOUTH OF CONDON CREEK.

Occurrence number: 025

COUNTY: MISSOULA

Township & Range: 021N016W Section: 18 Subsection/additional sections: S2SE4SW4

Latitude: 473421 Longitude: 1134206 Elevation: 3750

USGS Quad: CONDON

Location: SWAN VALLEY, 3.08 AIR MILES NORTH OF CONDON, 2.18 AIR MILES
EAST OF ST. HWY 83, 0.45 AIR MILES SOUTH OF CONDON CREEK.

Occurrence number: 026

COUNTY: MISSOULA

Township & Range: 021N016W Section: 18 Subsection/additional sections: SE4NW4SW4

Latitude: 473432 Longitude: 1134225 Elevation: 3710

USGS Quad: CONDON

Location: SWAN VALLEY, 3.29 AIR MILES NORTH OF CONDON, 1.97 AIR MILES
EAST OF ST. HWY 83, 0.28 AIR MILES SOUTH OF CONDON CREEK.

Occurrence number: 027

COUNTY: MISSOULA

Township & Range: 021N016W Section: 18 Subsection/additional sections: NW4SW4SW4

Latitude: 473426 Longitude: 1134233 Elevation: 3690

USGS Quad: CONDON

Location: SWAN VALLEY, 3.18 AIR MILES NORTH OF CONDON, 1.84 AIR MILES
EAST OF ST. HWY 83, 0.40 AIR MILES SOUTH OF CONDON CREEK.DOG CREEK

Occurrence number: 018

COUNTY: LAKE

Township & Range: 021N017W Section: 02 Subsection/additional sections: SE4NW4SE4

Latitude: 473618 Longitude: 1134412 Elevation: 3660

USGS Quad: CONDON

Location: SWAN VALLEY, EAST SIDE OF FLATHEAD N.F. RD. #899 NEAR JUNC-
TION WITH RD. #124, 0.35 AIR MILES NORTH OF LAKE-MISSOULA
COUNTY LINE, CA. 5.5 AIR MILES NNW OF CONDON.

TABLE 1A. (cont.).

DOG CREEK (cont.)

Occurrence number: 019

COUNTY: LAKE

Township & Range: 021N017W Section: 02 Subsection/additional sections: S2NE4SW4

Latitude: 473618

Longitude: 1134441

Elevation: 3580

USGS Quad: CONDON

Location: SWAN VALLEY, 0.33 AIR MILES WEST OF JUNCTION OF FLATHEAD NF
 RDS. 899 AND 124, 0.33 AIR MILES NORTH OF LAKE-MISSOULA CO.
 LINE, CA. 5.5 AIR MILES NNW OF CONDON.

LINDBERGH LAKE

Occurrence number: 001

COUNTY: MISSOULA

Township & Range: 019N017W Section: 12 Subsection/additional sections: NE4SE4NW4

Latitude: 472521

Longitude: 1134231

Elevation: 4230

USGS Quad: CYGNET LAKE

Location: SWAN VALLEY, 0.68 AIR MILES NNE. FROM THE FIRST FORK ON
 LINDBERGH LAKE ROAD, CA. 2.5 MILES WEST FROM ST. HWY. 83.

Occurrence number: 036

COUNTY: MISSOULA

Township & Range: 019N016W Section: 07 Subsection/additional sections: SW4SW4NW4;T19NR17W:+

Latitude: 472514

Longitude: 1134148

Elevation: 4190

USGS Quad: CYGNET LAKE

Location: ALSO 12SE4SE4NE4; SWAN VALLEY, SOUTH SIDE OF LINDBERGH LAKE
 RD., CA. 1.87 AIR MILES WEST OF ST. HWY 83.

Occurrence number: 043

COUNTY: MISSOULA

Township & Range: 019N017W Section: 12 Subsection/additional sections: SW4NW4NW4

Latitude: 472526

Longitude: 1134303

Elevation: 4280

USGS Quad: CYGNET LAKE

Location: SWAN VALLEY, 0.76 AIR MILES NORTH OF LINDBERGH LAKE RD.,
 2.68 AIR MILES WEST OF ST. HWY 83.

Occurrence number: 044

COUNTY: MISSOULA

Township & Range: 019N017W Section: 12 Subsection/additional sections: S2SE4NE4, N2NE4SE4

Latitude: 472508

Longitude: 1134156

Elevation: 4215

USGS Quad: CYGNET LAKE

Location: SWAN VALLEY, SOUTHEAST OF LINDBERGH LAKE RD., 2.0 AIR MILES
 WEST OF ST. HWY 83.

TABLE 1A. (cont.).

LINDBERGH LAKE (cont.)

Occurrence number: 045

COUNTY: MISSOULA

Township & Range: 019N016W Section: 18 Subsection/additional sections: SE4SW4SE4

Latitude: 472354 Longitude: 1134058 Elevation: 4250

USGS Quad: CY6NET LAKE

Location: SWAN VALLEY, 1.83 AIR MILES ESE OF NORTH END OF LINDBERGH
LAKE, 1.08 AIR MILES SOUTH OF SWAN RIVER, CA. 2.0 AIR MILES
WEST OF ST. HWY 83.

Occurrence number: 046

COUNTY: MISSOULA

Township & Range: 019N016W Section: 18 Subsection/additional sections: SW4NW4NW4

Latitude: 472434 Longitude: 1134141 Elevation: 4230

USGS Quad: CY6NET LAKE

Location: SWAN VALLEY, 0.58 AIR MILES SOUTH OF SWAN RIVER, 2.13 AIR
MILES WEST OF ST. HWY 83.

Occurrence number: 047

COUNTY: MISSOULA

Township & Range: 019N016W Section: 18 Subsection/additional sections: SW4NE4NW4

Latitude: 472433 Longitude: 1134127 Elevation: 4215

USGS Quad: CY6NET LAKE

Location: SWAN VALLEY, 0.5 AIR MILES SOUTH OF SWAN RIVER, 1.95 AIR
MILES WEST OF ST. HWY 83.

Occurrence number: 048

COUNTY: MISSOULA

Township & Range: 019N016W Section: 18 Subsection/additional sections: SW4NE4NW4

Latitude: 472432 Longitude: 1134122 Elevation: 4215

USGS Quad: CY6NET LAKE

Location: SWAN VALLEY, 0.5 AIR MILES SOUTH OF SWAN RIVER, 1.89 AIR
MILES WEST OF ST. HWY 83.

Occurrence number: 051

COUNTY: MISSOULA

Township & Range: 019N017W Section: 24 Subsection/additional sections: NE4SE4NW4

Latitude: 472335 Longitude: 1134229 Elevation: 4425

USGS Quad: CY6NET LAKE

Location: SWAN VALLEY, 0.91 AIR MILES EAST OF EAST SHORE OF LINDBERGH
LAKE, 0.8 AIR MILES SSE OF SOUTH SHORE OF CY6NET LAKE, CA.
3.3 AIR MILES WEST OF ST. HWY 83.

TABLE 1A. (cont.)

LOST CREEK-CILLY CREEK PONDS

Occurrence number: 008

COUNTY: LAKE

Township & Range: 024N017W Section: 06 Subsection/additional sections: NW4SW4SE4

Latitude: 475148 Longitude: 1134933 Elevation: 3190

USGS Quad: CILLY CREEK

Location: SWAN VALLEY, CA. 4.5 AIR MILES SSE. OF SWAN LAKE (TOWN);
 0.3 AIR MILES EAST OF ST. HWY. 83; 0.68 AIR MILES SSW. OF
 CONFLUENCE OF NORTH AND SOUTH FORKS LOST CREEK.

Occurrence number: 009

COUNTY: LAKE

Township & Range: 024N017W Section: 07 Subsection/additional sections: NE4NE4NE4

Latitude: 475137 Longitude: 1134907 Elevation: 3250

USGS Quad: CILLY CREEK

Location: SWAN VALLEY, 0.6 AIR MILES EAST OF ST. HWY. 83, 0.6 AIR
 MILES SOUTH OF SOUTH FORK LOST CREEK, CA. 5.0 AIR MILES SSE
 OF SWAN LAKE (TOWN).

Occurrence number: 010

COUNTY: LAKE

Township & Range: 024N017W Section: 05 Subsection/additional sections: NW4SW4SW4

Latitude: 475150 Longitude: 1134857 Elevation: 3230

USGS Quad: CILLY CREEK

Location: SWAN VALLEY, 0.75 AIR MILES EAST OF ST. HWY 83, 0.3 AIR
 MILES SOUTH OF SOUTH FORK LOST CREEK, CA. 4.7 AIR MILES SSE
 OF SWAN LAKE (TOWN).

Occurrence number: 011

COUNTY: LAKE

Township & Range: 024N017W Section: 08 Subsection/additional sections: E2SE4NW4, NW4SW4NE4

Latitude: 475120 Longitude: 1134826 Elevation: 3290

USGS Quad: CILLY CREEK

Location: SWAN VALLEY, 1.05-1.2 AIR MILES EAST OF ST. HWY 83, 0.25 AIR
 MILES NNE OF CILLY CREEK, CA. 5.0 AIR MILES SSE OF SWAN LAKE
 (TOWN).

Occurrence number: 012

COUNTY: LAKE

Township & Range: 024N017W Section: 08 Subsection/additional sections: NE4SW4NW4, SE4NW4NW4

Latitude: 475125 Longitude: 1134848 Elevation: 3235

USGS Quad: CILLY CREEK

Location: SWAN VALLEY, 0.83 AIR MILES EAST OF ST. HWY 83, 0.37 AIR
 MILES NORTH OF CILLY CREEK, CA. 5.0 AIR MILES SSE OF SWAN
 LAKE (TOWN).

TABLE 1A. (cont.)

LOST CREEK-CILLY CREEK PONDS (cont.)

Occurrence number: 013

COUNTY: LAKE

Township & Range: 024N017W Section: 08 Subsection/additional sections: N2SW4NW4

Latitude: 475124 Longitude: 1134852 Elevation: 3240

USGS Quad: CILLY CREEK

Location: SWAN VALLEY, 0.79 AIR MILES EAST OF ST. HWY 83, 0.36 AIR
MILES NORTH OF CILLY CREEK, CA. 5.0 AIR MILES SSE OF SWAN
LAKE (TOWN).

Occurrence number: 014

COUNTY: LAKE

Township & Range: 024N017W Section: 08 Subsection/additional sections: NW4SW4NW4

Latitude: 475124 Longitude: 1134857 Elevation: 3245

USGS Quad: CILLY CREEK

Location: SWAN VALLEY, 0.72 AIR MILES EAST OF ST. HWY 83, 0.4 AIR
MILES NORTH OF CILLY CREEK, CA. 5.0 AIR MILES SSE OF SWAN
LAKE (TOWN).

Occurrence number: 015

COUNTY: LAKE

Township & Range: 024N017W Section: 08 Subsection/additional sections: NW4SW4NW4

Latitude: 475121 Longitude: 1134856 Elevation: 3245

USGS Quad: CILLY CREEK

Location: SWAN VALLEY, 0.73 AIR MILES EAST OF ST. HWY 83, 0.32 AIR
MILES NORTH OF CILLY CREEK, CA. 5.0 AIR MILES SSE OF SWAN
LAKE (TOWN).

Occurrence number: 016

COUNTY: LAKE

Township & Range: 024N017W Section: 08 Subsection/additional sections: NW4NW4SW4

Latitude: 475111 Longitude: 1134857 Elevation: 3240

USGS Quad: CILLY CREEK

Location: SWAN VALLEY, 0.71 AIR MILES EAST OF ST. HWY 83, 0.17 AIR
MILES NORTH OF CILLY CREEK, CA. 5.0 AIR MILES SSE OF SWAN
LAKE (TOWN).

Occurrence number: 017

COUNTY: LAKE

Township & Range: 024N017W Section: 08 Subsection/additional sections: NE4NW4SW4

Latitude: 475110 Longitude: 1134845 Elevation: 3230

USGS Quad: CILLY CREEK

Location: SWAN VALLEY, 0.85 AIR MILES EAST OF ST. HWY 83, 0.1 AIR
MILES NORTH OF CILLY CREEK, CA. 5.0 AIR MILES SSE OF SWAN
LAKE (TOWN).

TABLE 1A. (cont.)

SWAN RIVER OXBOW

Occurrence number: 005

COUNTY: LAKE

Township & Range: 025N018W Section: 35 Subsection/additional sections: NW4;34,NE4NE4;26,SW4

Latitude: 475327 Longitude: 1135117 Elevation: 3100

USGS Quad: SWAN LAKE

Location: CA. 3 MILES SOUTH OF THE VILLAGE OF SWAN LAKE ON ST. HWY.
 83, 0.9 MILES WEST ON PORCUPINE CREEK ROAD; 0.2-0.7 AIR MI.
 N. OF PORCUPINE CREEK ROAD.

SWAN RIVER WEST

Occurrence number: 007

COUNTY: LAKE

Township & Range: 024N018W Section: 14 Subsection/additional sections: SW4SE4SE4

Latitude: 474958 Longitude: 1135131 Elevation: 3190

USGS Quad: CILLY CREEK

Location: WEST SIDE OF SWAN VALLEY, 1.4 AIR MILES WEST OF ST. HWY. 83;
 0.57 AIR MILE WEST OF SWAN RIVER; CA. 6.5 AIR MILES SOUTH OF
 SWAN LAKE (TOWN).

TABLE 1B. *Howellia aquatilis* locations on areas other than U.S. Forest Service lands, Missoula County, Montana. Occurrences are clustered under the site name, and are then listed in numerical order.

CONDON CREEK

Occurrence number: 028

COUNTY: MISSOULA

Township & Range: 021N017W Section: 13 Subsection/additional sections: SE4SE4SE4

Latitude: 473422 Longitude: 1134240 Elevation: 3685

USGS Quad: CONDON

Location: SWAN VALLEY, 3.09 AIR MILES NORTH OF CONDON, 1.75 AIR MILES
EAST OF ST. HWY 83, 0.48 AIR MILES SOUTH OF CONDON CREEK.

Occurrence number: 029

COUNTY: MISSOULA

Township & Range: 021N016W Section: 19 Subsection/additional sections: NW4NW4NW4

Latitude: 473415 Longitude: 1134228 Elevation: 3690

USGS Quad: CONDON

Location: SWAN VALLEY, 2.97 AIR MILES NORTH OF CONDON, 1.88 AIR MILES
EAST OF ST. HWY 83, 0.59 AIR MILES SOUTH OF CONDON CREEK.

Occurrence number: 030

COUNTY: MISSOULA

Township & Range: 021N016W Section: 19 Subsection/additional sections: NE4NE4NW4

Latitude: 473416 Longitude: 1134204 Elevation: 3740

USGS Quad: CONDON

Location: SWAN VALLEY, 2.99 AIR MILES NORTH OF CONDON, 2.19 AIR MILES
EAST OF ST. HWY 83, 0.55 AIR MILES SOUTH OF CONDON CREEK.

Occurrence number: 031

COUNTY: MISSOULA

Township & Range: 021N017W Section: 13 Subsection/additional sections: E2NE4SW4, W2NW4SE4

Latitude: 473436 Longitude: 1134315 Elevation: 3620

USGS Quad: CONDON

Location: SWAN VALLEY, 3.36 AIR MILES NORTH OF CONDON, 1.33 AIR MILES
EAST OF ST. HWY 83, 0.32 AIR MILES SOUTH OF CONDON CREEK.

KRAFT CREEK

Occurrence number: 052

COUNTY: MISSOULA

Township & Range: 020N017W Section: 22 Subsection/additional sections: SE4

Latitude: 472829 Longitude: 1134432 Elevation: 4010

USGS Quad: CYGNET LAKE

Location: SWAN VALLEY, CA. 0.5 AIR MILES WNW OF NORTH END OF STONER
LAKE, 0.35 AIR MILES EAST OF GLACIER CREEK, 3.15 AIR MILES
WEST OF ST. HWY 83.

TABLE 1B. (cont.).

LINDBERGH LAKE

Occurrence number: 002

COUNTY: MISSOULA

Township & Range: 019N017W Section: 01 Subsection/additional sections: E2NE4SW4

Latitude: 472556 Longitude: 1134232 Elevation: 4175

USGS Quad: CY6NET LAKE

Location: SWAN VALLEY, 1.32 AIR MILES NORTH OF THE FIRST FORK ON
LINDBERGH LAKE RD., CA. 2.5 MI. WEST OF ST. HWY. 83.

Occurrence number: 003

COUNTY: MISSOULA

Township & Range: 019N016W Section: 07 Subsection/additional sections: E2SW4NW4, W2SE4NW4

Latitude: 472516 Longitude: 1134128 Elevation: 4150

USGS Quad: CY6NET LAKE

Location: SWAN VALLEY, 0.1 AIR MILES SOUTH OF LINDBERGH LAKE RD., CA.
1.5 MILES WEST OF ST. HWY. 83.

Occurrence number: 004

COUNTY: MISSOULA

Township & Range: 019N016W Section: 07 Subsection/additional sections: SE4NE4

Latitude: 472515 Longitude: 1134041 Elevation: 4070

USGS Quad: CY6NET LAKE

Location: SWAN VALLEY, CA. 50 FT. SOUTHWEST OF LINDBERGH LAKE RD.,
CA. 1 MILE WEST OF ST. HWY. 83.

Occurrence number: 032

COUNTY: MISSOULA

Township & Range: 019N016W Section: 07 Subsection/additional sections: SE4SW4NW4

Latitude: 472511 Longitude: 1134134 Elevation: 4165

USGS Quad: CY6NET LAKE

Location: SWAN VALLEY, 0.16 AIR MILES SOUTH OF LINDBERGH LAKE RD., CA.
1.75 AIR MILES WEST OF ST. HWY 83.

Occurrence number: 033

COUNTY: MISSOULA

Township & Range: 019N016W Section: 07 Subsection/additional sections: N2SE4NW4

Latitude: 472520 Longitude: 1134119 Elevation: 4130

USGS Quad: CY6NET LAKE

Location: SWAN VALLEY, 0.05 AIR MILES SOUTH OF LINDBERGH LAKE RD., CA.
1.5 AIR MILES WEST OF ST. HWY 83.

TABLE 1B. (cont.).

LINDBERGH LAKE (cont.)

Occurrence number: 034

COUNTY: MISSOULA

Township & Range: 019N016W Section: 07 Subsection/additional sections: NE4NE4SW4

Latitude: 472507 Longitude: 1134116 Elevation: 4145

USGS Quad: CYGNET LAKE

Location: SWAN VALLEY, 0.3 AIR MILES SOUTH OF LINDBERGH LAKE RD., CA.
1.5 AIR MILES WEST OF ST. HWY 83.

Occurrence number: 035

COUNTY: MISSOULA

Township & Range: 019N016W Section: 07 Subsection/additional sections: E2NE4SW4

Latitude: 472502 Longitude: 1134114 Elevation: 4150

USGS Quad: CYGNET LAKE

Location: SWAN VALLEY, 0.38 AIR MILES SOUTH OF LINDBERGH LAKE RD., CA.
1.5 AIR MILES WEST OF ST. HWY 83.

Occurrence number: 037

COUNTY: MISSOULA

Township & Range: 019N017W Section: 01 Subsection/additional sections: SW4NE4SE4

Latitude: 472551 Longitude: 1134203 Elevation: 4170

USGS Quad: CYGNET LAKE

Location: SWAN VALLEY, 0.93 AIR MILES NORTH OF LINDBERGH LAKE RD., CA.
1.69 AIR MILES WEST OF ST. HWY 83.

Occurrence number: 038

COUNTY: MISSOULA

Township & Range: 019N017W Section: 01 Subsection/additional sections: E2SW4NE4

Latitude: 472608 Longitude: 1134215 Elevation: 4130

USGS Quad: CYGNET LAKE

Location: SWAN VALLEY, 1.33 AIR MILES NORTH OF LINDBERGH LAKE RD., CA.
1.62 AIR MILES WEST OF ST. HWY 83.

Occurrence number: 039

COUNTY: MISSOULA

Township & Range: 019N017W Section: 01 Subsection/additional sections: SW4NE4SW4, SE4NW4SW4

Latitude: 472550 Longitude: 1134244 Elevation: 4190

USGS Quad: CYGNET LAKE

Location: SWAN VALLEY, 1.25 AIR MILES NORTH OF LINDBERGH LAKE RD., CA.
2.21 AIR MILES WEST OF ST. HWY 83.

TABLE 1B. (cont.).

LINDBERGH LAKE (cont.).

Occurrence number: 040

COUNTY: MISSOULA

Township & Range: 019N017W Section: 01 Subsection/additional sections: SW4SE4SW4

Latitude: 472539 Longitude: 1134244 Elevation: 4225

USGS Quad: CYGNET LAKE

Location: SWAN VALLEY, 1.03 AIR MILES NORTH OF LINDBERGH LAKE RD., CA.

2.32 AIR MILES WEST OF ST. HWY 83.

Occurrence number: 041

COUNTY: MISSOULA

Township & Range: 019N016W Section: 05 Subsection/additional sections: N2SW4SW4

Latitude: 472541 Longitude: 1134028 Elevation: 4015

USGS Quad: CYGNET LAKE

Location: SWAN VALLEY, 0.6 AIR MILES NORTH OF LINDBERGH LAKE RD., 0.53

AIR MILES WEST OF ST. HWY 83.

Occurrence number: 042

COUNTY: MISSOULA

Township & Range: 019N016W Section: 05 Subsection/additional sections: N2SW4SW4

Latitude: 472544 Longitude: 1134024 Elevation: 3995

USGS Quad: CYGNET LAKE

Location: SWAN VALLEY, 0.7 AIR MILES NORTH OF LINDBERGH LAKE RD., 0.43

AIR MILES WEST OF ST. HWY 83.

Occurrence number: 049

COUNTY: MISSOULA

Township & Range: 019N016W Section: 07 Subsection/additional sections: SW4SW4SE4

Latitude: 472444 Longitude: 1134107 Elevation: 4150

USGS Quad: CYGNET LAKE

Location: SWAN VALLEY, 0.16 AIR MILES SOUTH OF SWAN RIVER, 1.60 AIR

MILES WEST OF ST. HWY 83.

Occurrence number: 050

COUNTY: MISSOULA

Township & Range: 019N017W Section: 13 Subsection/additional sections: NE4NE4NW4

Latitude: 472437 Longitude: 1134232 Elevation: 4295

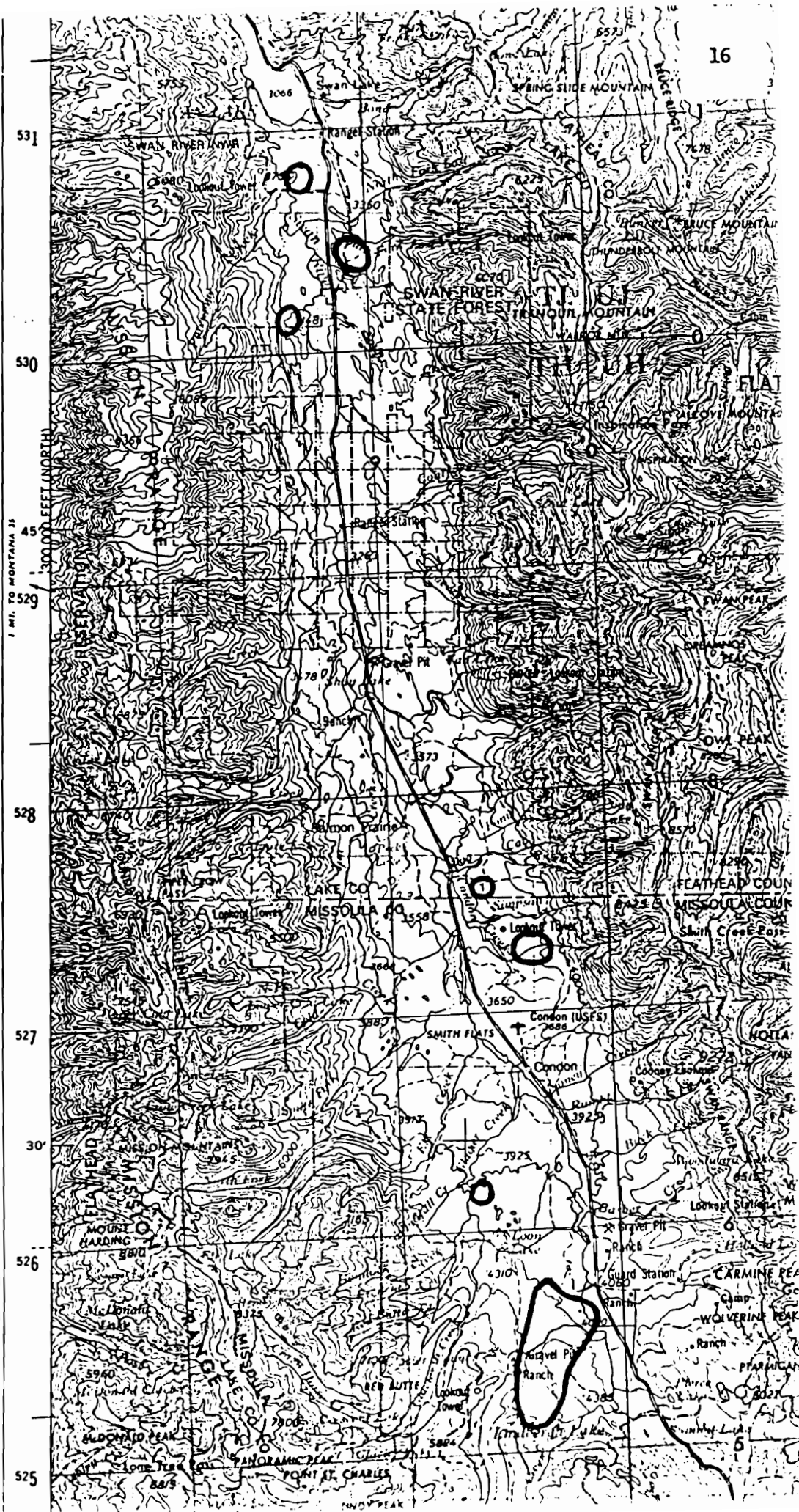
USGS Quad: CYGNET LAKE

Location: SWAN VALLEY, 0.25 AIR MILES ENE OF SWAN RIVER OUTLET FROM

CYGNET LAKE, 0.1 AIR MILES SOUTH OF SWAN RIVER, CA. 2.8 AIR

MILES WEST OF ST. HWY 83.

Figure 1.
Geographic
distribution of
Howellia aquatilis,
Swan Valley,
Montana.



36 support populations, and 136 apparently do not. Thus, of the 348 areas surveyed, H. aquatilis has been found in 52 (14.9%) of them. Some of the locations of ponds and other wetland habitats where the species has not been found are indicated on the occurrence maps provided in Section IV, pp. 94-101. Information on other areas surveyed, where H. aquatilis was not found, is contained on the additional maps in Section IV, pp. 102-112.

E. HABITAT

1. ASSOCIATED VEGETATION (MONTANA): Howellia aquatilis is most often found in small pothole ponds of glacial origin, in the lower elevations of the Swan River Valley. The zonal vegetation in these areas consists of diverse coniferous forests, which include varying amounts of the following tree species:

Abies grandis (Grand Fir)
Abies lasiocarpa (Subalpine Fir)
Larix occidentalis (Western Larch)
Picea engelmannii (Engelmann Spruce)
Pinus contorta (Lodgepole Pine)
Pinus monticola (Western White Pine)
Pinus ponderosa (Ponderosa Pine)
Pseudotsuga menziesii (Douglas Fir)

Immediately surrounding the ponds in which H. aquatilis has been found, the following deciduous broadleaf tree species are virtually always present: Populus tremuloides (Quaking Aspen) and/or Populus trichocarpa (Black Cottonwood). In the northern Swan Valley, Betula papyrifera (Paper Birch) is associated with some sites.

Shrub species bordering H. aquatilis sites include:

Alnus incana (Thinleaf Alder)
Cornus stolonifera (Red Osier Dogwood)
Juniperus communis (Common Juniper)
Rhamnus alnifolia (Alder Buckthorn)
Salix spp. (Willows)

The following aquatic herbaceous species were found to be commonly associated with H. aquatilis; those marked with an asterisk can be considered indicator species:

*Carex vesicaria (Inflated Sedge)

NOTE:

Owing to documented population fluctuations (discussed in Section I.F.2., p. 21), there is a possibility that ponds which were surveyed, but which were not observed to support populations, may in fact contain H. aquatilis. Future surveys in some or all of these locations would be needed to verify the absence of the species.

Callitriche heterophylla (Different-leaved Water-starwort)

*Equisetum fluviatile (Water Horsetail)

Potamogeton gramineus (Variable Leaf Pondweed)

Ranunculus aquatilis (Hairleaf Water Buttercup)

*Sium suave (Hemlock Water-parsnip)

Sparganium minimum (Small Bur-reed)

Other species less frequently found in association with H. aquatilis include:

Alisma plantago-aquatica (American Waterplantain)

Alopecurus aequalis (Shortawn Foxtail)

Carex atherodes (Slough Sedge)

Carex rostrata (Beaked Sedge)

Eleocharis palustris (Common Spikesedge)

Glyceria borealis (Northern Mannagrass)

Myriophyllum spicatum (Spiked Water-milfoil)

Nuphar variegatum (Yellow Water-lily)

Phalaris arundinacea (Reed Canarygrass)

Ranunculus gmelinii (Gmelin's Buttercup)

Sagittaria cuneata (Duckpotato Arrowhead)

Typha latifolia (Common Cattail)

Utricularia vulgaris (Common Bladderwort)

Veronica catenata (Chain Speedwell)

2. TOPOGRAPHY: The topography of the Swan Valley is of glacial origin. Generally, the floor of the valley is level to gently sloping, with drumlins in numerous areas. The pothole ponds in which H. aquatilis most often occurs formed upon the retreat of the glacier about 10,000 years ago. These ponds could represent depressions left when masses of ice buried in outwash gravels melted; they could also be formed when areas of ice melted out between areas of outwash sediments which accumulated upon the glacier surface (Alt and Hyndman, 1986).

The sites for H. aquatilis in Montana range from 945 m (3100 ft.) near the south end of Swan Lake, to 1348 m (4420 ft.) near the east side of Lindbergh Lake.

3. SOIL AND WATER CHEMISTRY RELATIONSHIPS:

- a. SOIL RELATIONSHIPS: Howellia aquatilis is found almost exclusively in ponds with bottom surfaces which consist of firm, consolidated clay and organic sediments. Only in two cases were plants found in ponds with deeper, largely unconsolidated bottom sediments; in these situations, most H. aquatilis plants were then found in shallower

areas near the shore, in more consolidated portions of the ponds. The texture and depth of these bottom sediments may be very important in relation to seed germination requirements and early growth of H. aquatilis. Loose, silty soil sediments may lead to burial of seeds too deeply to ensure efficient germination and establishment.

The soil units which comprise the Swan Valley floor consist of Cryochrepts, Eutroborafts, and Eutrochrepts. The parent materials for these soils consist of clayey alluvium and clayey colluvium; the resultant soils are deep (Montagne et al., 1982).

The Swan River Oxbow (005) site is unusual in that the H. aquatilis populations occupy areas in and near an old, retired oxbow of the previous river channel. The site is physiographically very different from the glacial pothole depressions which the species inhabits elsewhere in the Swan Valley. However, the bottom sediments of the sloughs are of a similar consolidated texture, and many of the common associated species are present, especially Carex vesicaria and Equisetum fluviatile.

- b. WATER CHEMISTRY: Water samples from nine ponds supporting H. aquatilis, and three ponds not supporting the species, were analyzed to determine pH (acidity) and conductivity (ability of an aqueous solution to carry an electric current, depending on the presence, concentration, mobility, valence, and relative concentrations of ions). In addition, five samples (three from H. aquatilis ponds, two from others) were analyzed to determine alkalinity (acid-neutralizing capacity). The analyses were conducted by the Montana Department of Health and Environmental Sciences, Chemistry Laboratory Bureau. The results of these analyses are presented in Table 2.

None of the factors analyzed appear to distinguish among ponds supporting or not supporting H. aquatilis. The pH for ponds with or without the species are all in the neutral range (6.75-7.92). It is possible that other factors which were not analyzed are more important in determining the suitability of a particular site for

TABLE 2. WATER CHEMISTRY ANALYSES, SWAN VALLEY, LAKE AND MISSOULA COUNTIES, MONTANA.

A. Ponds containing Howellia aquatilis:

<u>Sample</u> (Occ. Number)	<u>pH</u>	<u>Conductivity</u> (umho/cm @ 25°C)	<u>Alkalinity</u> (mg/L as CaCO ₃)
A-2 (007)	7.20	73	32
C-1 (020)	7.28	87	44
C-3 (027)	7.66	266	130
D-1 (008)	7.57	322	-
D-3 (014)	7.00	162	-
E-1 (049)	7.29	73	-
F-1 (018)	6.78	68	-
G-1 (031)	7.13	54	-
H-1 (051)	6.85	33	-
\bar{x}	7.20	126	69

B. Ponds not containing Howellia aquatilis:

B-1 (near 007)	7.61	210	103
C-2 (near 021)	6.75	30	10
D-2 (near 008)	7.92	216	-
\bar{x}	7.43	152	56

supporting H. aquatilis (i.e., dissolved oxygen).

4. REGIONAL CLIMATE: The climate of the Swan Valley can generally be classified as temperate and moist. Near the distributional area of H. aquatilis in Montana, the closest climatological stations are located in Bigfork (3010 ft. (918 m.) elevation) and Seeley Lake (4100 ft. (1250 m.) elevation). Data for the period 1951-1980 are provided by the U.S. Department of Commerce (1982). At Bigfork, the mean annual precipitation was 56.08 cm. (22.08 in.); the mean annual temperature was 7.5° C (45.5° F), and the mean July maximum temperature was 27.6° C (81.7° F). At Seeley Lake, the mean annual precipitation was 56.16 cm. (22.11 in.); the mean annual temperature was 5.2° C (41.3° F), and the mean July maximum temperature was 27.8° C (82.0° F).

F. POPULATION DEMOGRAPHY AND BIOLOGY

1. PHENOLOGY: The submerged, cleistogamous flowers of H. aquatilis are generally formed in May and early June in Montana. The conspicuous emergent flowers are in bloom from late June to August; blooming can actually continue as long as adequate water remains in the vernal ponds which it inhabits.

In Washington, emergent flowers have been found in early May. The sites in eastern Washington are probably free of ice much earlier in the growing season.

Fruiting begins very soon after the formation of the early cleistogamous flowers in May, and continues as long as blooming proceeds into late summer.

2. POPULATION SIZE AND CONDITION (MONTANA): Because H. aquatilis is an annual species which occurs in vernal pothole ponds, its population sizes fluctuate from year to year depending on seasonal conditions. For example, at the Swan River Oxbow (005) site approximately 10,000 plants were observed in 1985, but fewer than 100 plants were seen in 1986 (Lesica *et al.*, 1987a). During field surveys in 1987, the population was very large again, with many hundreds of plants observed. Lesica (pers. comm.) observed approximately 1000 plants in one of the Condon Creek populations (023) in 1986; in 1987, only three plants could be found. Thus, population estimates from one season

may not provide an accurate assessment of the species' abundance.

During field surveys in 1987, the smallest population was at Condon Creek (023): three plants, as mentioned above. The largest estimated population was the Swan River West site (007): 3000-4000+ plants.

Twelve populations have been found in which the former or recent estimated population size was more than 1000 individuals:

Condon Creek (006, 020, 030)
 Lindbergh Lake (002, 003, 038, 039, 049)
 Lost Creek-Cilly Creek Ponds (008, 013)
 Swan River Oxbow (005)
 Swan River West (007)

Twenty-six populations have been estimated to contain 101-1000 plants, and 14 have been observed to contain 100 or fewer plants. Details regarding population size and condition are summarized in Table 3.

3. REPRODUCTIVE BIOLOGY

- a. TYPE OF REPRODUCTION: In the submerged, cleistogamous flowers of H. aquatilis, the corollas do not develop or open fully, and these flowers are thus strictly self-pollinating. Additionally, evidence indicates that the emergent, more fully-developed flowers are also self-pollinating (Lesica et al., 1987b). Thin microscopic sections of emergent flower buds show the anthers to be dehiscing (shedding pollen), and embryos developing, before the corolla is fully developed or open. Additionally, during the course of field surveys in 1987, no pollinators or other insects were observed visiting the emergent flowers, further substantiating the hypothesis that H. aquatilis is an obligate self-pollinator.
- b. SEED DISPERSAL AND BIOLOGY: The seeds of H. aquatilis are relatively large, being 2-4 mm. long. They do not possess any wings, appendages, or other structures which appear to provide them with any buoyancy. Though capable of floating on the surface owing to water surface tension, the seeds sink readily when pushed or released below the surface. It is likely that all of the seeds produced

TABLE 3. Population size and condition, Howellia aquatilis, Missoula and Lake Counties, Montana.

Occurrence number: 001

Site name: LINDBERGH LAKE

Acreage: 2

Population size and condition: EST. 75-100+ PLANTS (1987); NORTH END OF POND IMPACTED BY LOGGING, WITH SOME SLASH PILED INTO THE WATER.

Occurrence number: 002

Site name: LINDBERGH LAKE

Acreage: 4

Population size and condition: EST. 2000-3000 PLANTS (1987); NORTH AND WEST MARGINS OF POND DISTURBED BY LOGGING ACTIVITY; DEEPEST POND KNOWN FOR THE SPECIES IN MONTANA (CA. EIGHT FEET); SOME INDIVIDUALS VERY LARGE.

Occurrence number: 003

Site name: LINDBERGH LAKE

Acreage: 2

Population size and condition: 1000+ PLANTS (1983); POND IS A SMALL GLACIAL DEPRESSION NEXT TO A LARGER BOG, TO WHICH IT MAY HAVE BEEN CONNECTED EARLIER.

Occurrence number: 004

Site name: LINDBERGH LAKE

Acreage: 1

Population size and condition: EST. 11-50 PLANTS (1983).

Occurrence number: 005

Site name: SWAN RIVER OXBOW

Acreage: 30

Population size and condition: VERY COMMON; MAY BE LARGEST OCCURRENCE KNOWN, WITH ABOUT 10000 INDIVIDUALS (1985); ELEMENT OCCURS IN 4 AREAS, IN AND ADJACENT TO THE OLD RIVER OXBOW; MANY HUNDREDS OF PLANTS OBSERVED IN 1987.

Occurrence number: 006

Site name: CONDON CREEK

Acreage: 1

Population size and condition: EST. 1000-2000 PLANTS (1987); MANY PLANTS DISTURBED BY MOOSE AND/OR WATERFOWL ACTIVITY; AREA IS ACTIVELY THREATENED BY LOGGING ROAD CONSTRUCTION AND TIMBER HARVESTING.

TABLE 3. (cont.).

Occurrence number: 007

Site name: SWAN RIVER WEST

Acreage: 1

Population size and condition: ABOUT 3000-4000 PLANTS, POSSIBLY MORE; VERY DENSE, AND FORMING MATS, IN WEST POND; THE TWO PONDS, WHICH ARE SEPARATED BY A SALIX BORDER, ARE JOINED BY HIGHER WATER IN THE SPRING.

Occurrence number: 008

Site name: LOST CREEK-CILLY CREEK PONDS

Acreage: 2

Population size and condition: EST. 2000-3000 PLANTS, IN A SINGLE POND; SURROUNDED BY A RELATIVELY UNDISTURBED FOREST, WHICH WAS REPORTEDLY LIGHTLY SELECTIVELY LOGGED IN ABOUT 1910.

Occurrence number: 009

Site name: LOST CREEK-CILLY CREEK PONDS

Acreage: 3

Population size and condition: EST. 500-600 PLANTS (1987); SPECIES DOES NOT OCCUPY ALL OF THE AVAILABLE, SUITABLE HABITAT AT THIS SITE; AREAS AROUND SOUTH AND EAST SIDES OF POND CLEARCUT CA. 15 YEARS AGO.

Occurrence number: 010

Site name: LOST CREEK-CILLY CREEK PONDS

Acreage: 2

Population size and condition: EST. 200-300 PLANTS (1987); FLOWERS AND CLEISTOGAMOUS FRUIT; SPECIES DOES NOT OCCUPY ALL OF THE AVAILABLE, SUITABLE HABITAT AT THIS SITE; AREAS AROUND SOUTH AND EAST SIDES OF POND CLEARCUT CA. 15 YEARS AGO.

Occurrence number: 011

Site name: LOST CREEK-CILLY CREEK PONDS

Acreage: 5

Population size and condition: EST. 100-200 PLANTS (1987), ON SOUTHWEST, NORTH AND EAST MARGINS; PAST LOGGING DISTURBANCE IN THE AREA.

Occurrence number: 012

Site name: LOST CREEK-CILLY CREEK PONDS

Acreage: 2

Population size and condition: EST. 400-500 PLANTS (1987); MUCH OF POND HAS NO VEGETATION; LOGGING HAS OCCURRED AROUND POND.

TABLE 3. (cont.).

Occurrence number: 013

Site name: LOST CREEK-CILLY CREEK PONDS

Acreage: 2

Population size and condition: EST. 1000-1500 PLANTS (1987); LOGGING HAS OCCURRED AROUND POND.

Occurrence number: 014

Site name: LOST CREEK-CILLY CREEK PONDS

Acreage: 2

Population size and condition: EST. 300-400 PLANTS (1987); LOGGING HAS OCCURRED IN ADJACENT FORESTS.

Occurrence number: 015

Site name: LOST CREEK-CILLY CREEK PONDS

Acreage: 2

Population size and condition: EST. 300+ PLANTS (1987); LOGGING HAS OCCURRED IN ADJACENT FORESTS; THIS POND WAS DRYING FASTER THAN OTHERS AT THIS SITE.

Occurrence number: 016

Site name: LOST CREEK-CILLY CREEK PONDS

Acreage: 2

Population size and condition: EST. 400+ PLANTS (1987); ADJACENT TO LOGGING ROAD.

Occurrence number: 017

Site name: LOST CREEK-CILLY CREEK PONDS

Acreage: 3

Population size and condition: EST. 10-12 PLANTS (1987); ADJACENT TO LOGGING ROAD; THIS DEPRESSION WAS MUCH DRYER THAN THE OTHERS, HOWELLIA AQUATILIS PRESENT IN A FEW PUDDLES; HABITAT MAY BE MORE ADVANCED SUCCESSIONALLY THAN NEARBY PONDS.

Occurrence number: 018

Site name: DOG CREEK

Acreage: 2

Population size and condition: EST. 200+ PLANTS (1987); SURROUNDING FOREST LOGGED.

Occurrence number: 019

Site name: DOG CREEK

Acreage: 2

Population size and condition: EST. 150-200 PLANTS (1987); FOREST IMMEDIATELY SURROUNDING POND IN GOOD CONDITION, FAIRLY UNDISTURBED.

TABLE 3. (cont.).

Occurrence number: 020
Site name: CONDON CREEK
Acreage: 2
Population size and condition: EST. 1000 PLANTS (1987); NEARBY FORESTS RECENTLY LOGGED.

Occurrence number: 021
Site name: CONDON CREEK
Acreage: 1
Population size and condition: EST. 50 PLANTS (1987); NEARBY FORESTS RECENTLY LOGGED.

Occurrence number: 022
Site name: CONDON CREEK
Acreage: 1
Population size and condition: EST. 200 PLANTS (1987); NEARBY FORESTS RECENTLY LOGGED.

Occurrence number: 023
Site name: CONDON CREEK
Acreage: 1
Population size and condition: 3 PLANTS (1987); SEVERAL HUNDRED PLANTS OBSERVED IN 1986 BY
P. LESICA; NEARBY FORESTS RECENTLY LOGGED.

Occurrence number: 024
Site name: CONDON CREEK
Acreage: 1
Population size and condition: EST. 30 PLANTS (1987); NEARBY FORESTS RECENTLY LOGGED.

Occurrence number: 025
Site name: CONDON CREEK
Acreage: 2
Population size and condition: EST. 25 PLANTS (1987); POND MARGINS RECENTLY DISTURBED BY
LOGGING.

Occurrence number: 026
Site name: CONDON CREEK
Acreage: 1
Population size and condition: EST. 200-300 PLANTS (1987); NEARBY FORESTS RECENTLY LOGGED.

Occurrence number: 027
Site name: CONDON CREEK
Acreage: 2
Population size and condition: EST. 300 PLANTS (1987); SOUTH MARGIN OF POND RECENTLY DIS-
TURBED BY LOGGING.

TABLE 3. (cont.).

Occurrence number: 028

Site name: CONDON CREEK

Acreage: 1

Population size and condition: EST. 200-250 PLANTS (1987); ADJACENT USFS LAND RECENTLY LOGGED.

Occurrence number: 029

Site name: CONDON CREEK

Acreage: 2

Population size and condition: EST. 200-300 PLANTS (1987); POND MARGINS RECENTLY DISTURBED BY LOGGING.

Occurrence number: 030

Site name: CONDON CREEK

Acreage: 1

Population size and condition: EST. 1000 PLANTS (1987); POND MARGINS RECENTLY DISTURBED BY LOGGING.

Occurrence number: 031

Site name: CONDON CREEK

Acreage: 2

Population size and condition: EST. 150-175 PLANTS (1987); AREA DISTURBED BY LOGGING IN THE PAST; POND ADJACENT TO A LOGGING ROAD; PLANTS FOUND IN CALM, SHALLOW AREAS UNDER SHRUBS BORDERING POND, AND ADJACENT TO LOGS.

Occurrence number: 032

Site name: LINDBERGH LAKE

Acreage: 2

Population size and condition: EST. 101-1000 PLANTS (1983).

Occurrence number: 033

Site name: LINDBERGH LAKE

Acreage: 1

Population size and condition: EST. 50 PLANTS (1983); THIS SLOUGH HAS A FLOATING SEDGE MAT, AND IS DOMINATED BY TYPHA, AND THUS IS APPARENTLY MORE SUCCESSIONALLY ADVANCED THAN OTHERS IN THE AREA.

Occurrence number: 034

Site name: LINDBERGH LAKE

Acreage: 2

Population size and condition: EST. 11-100 PLANTS (1983).

TABLE 3. (cont.).

Occurrence number: 035

Site name: LINDBERGH LAKE

Acreage: 2

Population size and condition: EST. 51-1000 PLANTS (1983).

Occurrence number: 036

Site name: LINDBERGH LAKE

Acreage: 1

Population size and condition: EST. 100-125 PLANTS (1987); PLANTS ARE FOUND AT SOUTHEAST
END OF POND, ON SECTION LINE.

Occurrence number: 037

Site name: LINDBERGH LAKE

Acreage: 1

Population size and condition: EST. 10-15 PLANTS (1987); POND DISTURBED BY HEAVY LOGGING ON
ALL SIDES; PLANTS FOUND IN SOUTH END OF POND.

Occurrence number: 038

Site name: LINDBERGH LAKE

Acreage: 2

Population size and condition: EST. 1000-1200 PLANTS (1987); POND DISTURBED BY HEAVY
LOGGING ON ALL SIDES.

Occurrence number: 039

Site name: LINDBERGH LAKE

Acreage: 2

Population size and condition: EST. 1000-1500 PLANTS (1987); POND DAMAGED BY LOGGING ON
NORTHEAST SIDE.

Occurrence number: 040

Site name: LINDBERGH LAKE

Acreage: 2

Population size and condition: EST. 300-400 PLANTS (1987); FOREST IMMEDIATELY SURROUNDING
POND CURRENTLY UNDISTURBED.

Occurrence number: 041

Site name: LINDBERGH LAKE

Acreage: 1

Population size and condition: FOUR PLANTS (1987); POND AND SURROUNDING FOREST UNDERSTORY
HEAVILY DISTURBED BY LIVESTOCK GRAZING; PLANTS FOUND ON EAST
EDGE OF POND.

TABLE 3. (cont.).

Occurrence number: 042

Site name: LINDBERGH LAKE

Acreage: 3

Population size and condition: EST. 50-60 PLANTS (1987); POND AND SURROUNDING FOREST UNDERSTORY DISTURBED BY LIVESTOCK GRAZING; PLANTS FOUND IN NORTH, NE, AND SOUTH PORTIONS OF POND; MOST PLANTS FOUND IN AN ARM ON NE SIDE OF POND.

Occurrence number: 043

Site name: LINDBERGH LAKE

Acreage: 1

Population size and condition: EST. 20-25 PLANTS (1987).

Occurrence number: 044

Site name: LINDBERGH LAKE

Acreage: 1

Population size and condition: EST. 275-400 PLANTS (1987); POND IS ALONGSIDE A HEAVILY USED GRAVEL ROAD, AND IS UNDER A POWER LINE.

Occurrence number: 045

Site name: LINDBERGH LAKE

Acreage: 2

Population size and condition: EST. 300 PLANTS (1987).

Occurrence number: 046

Site name: LINDBERGH LAKE

Acreage: 1

Population size and condition: EST. 50 PLANTS (1987); ADJACENT AREAS DISTURBED BY CLEARCUT LOGGING.

Occurrence number: 047

Site name: LINDBERGH LAKE

Acreage: 1

Population size and condition: EST. 200 PLANTS (1987); POND LOCATED ON EDGE OF A CLEARCUT.

Occurrence number: 048

Site name: LINDBERGH LAKE

Acreage: 1

Population size and condition: EST. 250 PLANTS (1987); ADJACENT AREAS DISTURBED BY CLEARCUT LOGGING.

TABLE 3. (cont.).

Occurrence number: 049

Site name: LINDBERGH LAKE

Acreage: 1

Population size and condition: EST. 1500-2000 PLANTS (1987); POND IS ON NORTH SIDE OF A
NEWLY CONSTRUCTED LOGGING ROAD, JUST NORTH OF USFS BOUNDARY.

Occurrence number: 050

Site name: LINDBERGH LAKE

Acreage: 3

Population size and condition: EST. 500-1000 PLANTS (1987); MOSTLY ON THE POND MARGIN, IN
THE MORE OPEN ZONE BETWEEN THE EMERGENT VEGETATION AND THE
SHORELINE, UNDER OVERHANGING SHRUB COVER; A FEW PLANTS OUT
IN DEEPER WATER.

Occurrence number: 051

Site name: LINDBERGH LAKE

Acreage: 1

Population size and condition: EST. 100-125 PLANTS (1987); VERY SMALL POND, MOSTLY DRY EX-
CEPT FOR CENTER WHERE PLANTS WERE FOUND.

Occurrence number: 052

Site name: KRAFT CREEK

Acreage: 1

Population size and condition: EST. 200 PLANTS (1987); A FEW PLANTS IN MUD ON POND MARGIN
STILL FLOWERING ON DATE OF SURVEY; ENTIRE POND NOT SURVEYED.

by the submergent cleistogamous flowers sink to the bottom upon release. Although seeds released from emergent capsules could float for a short distance from the point of dispersal, it is likely that these seeds sink fairly soon after release as well.

The majority of the populations of H. aquatilis occur in ponds which are not connected by drainages or by spring run-off. The exception to this is the Swan River Oxbow (005) site, where the species occurs in four adjacent wetlands on the floodplain of the Swan River. During years of high spring run-off, this area is inundated, and it is likely that these wetlands are thus interconnected. Water from the Swan River was observed flowing through the surrounding forests in June, 1986. In this situation, it is possible that some dispersal of seed by water movement is occurring.

Another possible means of seed dispersal for H. aquatilis is by wildlife dissemination. Waterfowl were frequently observed in the pothole ponds; it is likely that, when feeding on aquatic vegetation, these birds could ingest H. aquatilis and distribute the seeds later in other ponds. Seed movement in pond sediments on their appendages may also occur. This mode of seed dispersal could explain the scattered distribution of the seven sites in the Swan Valley, and the clustered arrangement of adjacent populations at the Lost Creek-Cilly Creek Ponds (008-017), Dog Creek (018, 019), Condon Creek (020-031), and Lindbergh Lake (001-004, 032-051) sites.

In addition, seed movement by mammals (i.e., deer, bears, moose) also appears to be possible. Deer and moose browse in such ponds, and could thus ingest and transport seeds. Signs of bear foraging were noted at the Lost Creek-Cilly Creek site (008) late in the summer, after all water had dried from the pond; dispersal between ponds could perhaps also occur in this way.

Evidence for the presence of a seed bank is reported by Lesica et al. (1987a). At the Swan River Oxbow (005) site, examination of the surface 3 cm of soil from three 2.25 dm² quadrats in 1986 yielded an estimate of

approximately 200 seeds/m². The presence of such a seed bank should help buffer the occurrences from periodic environmental fluctuations which result in varying population sizes.

G. POPULATION ECOLOGY

1. **SUCCESSIONAL RELATIONSHIPS:** The pothole ponds inhabited by H. aquatilis appear to be at an early stage within the successional series for such habitats in the Swan Valley. In classifications of wetland habitat types, such ponds could generally be classified as inland shallow fresh marshes (Shaw and Fredine, 1956) or seasonal ponds (Stewart and Kantrud, 1971). Such wetlands are often characterized by aquatic grasses (i.e., Glyceria spp., Alopecurus aequalis) and sedges (i.e., Carex vesicaria, C. rostrata, C. atherodes), pondweeds (Potamogeton spp.), and burreeds (Sparganium spp.) (Weller, 1981). With increasing sedimentation and accumulation of organic matter, and subsequent lowering of the water table, such habitats can eventually develop into sedge meadows (Reuter, 1986). Numerous examples of such meadows can be found in the Swan Valley, dominated most often by Carex lasiocarpa. In these sedge meadows, the water table is at or below the soil surface; such sites were never observed to support H. aquatilis.

The characteristic which may be most important in maintaining the pothole ponds inhabited by H. aquatilis is that they generally always dry completely by the end of the growing season (late August-September). Such drying inhibits the rate of muck accumulation (Reuter, 1986), and may serve to maintain these ponds in an earlier emergent stage.

In ponds which are more successional advanced, and which may remain wetter for most of the growing season, Typha latifolia and Nuphar variegatum are more frequent. Howellia aquatilis occurs in association with T. latifolia in 12 such ponds or wetlands (Condon Creek (031), Dog Creek (018), Lindbergh Lake (004, 012, 032, 033, 037, 040, 042, 046, 047, 048), and Swan River Oxbow (005)); it is associated with N. variegatum in three locations (Lost Creek-Cilly Creek Ponds (011, 012), Lindbergh lake (047)). In many cases, these ponds were found to support less vigorous populations of H. aquatilis, possibly reflecting their advancing successional stage, and increased

unconsolidated bottom sediments.

2. **COMPETITION:** In general, Howellia aquatilis was observed to occupy less densely vegetated areas within the pothole ponds where it occurs. Two patterns were observed in particular: 1.) in many ponds, the greatest densities of H. aquatilis were found around the pond margins, under the cover of surrounding overhanging shrubs (Salix spp., Alnus incana, Cornus stolonifera). In this zone, other emergent aquatic species do not occur in abundance, and H. aquatilis is able to spread throughout such open areas, often growing in thick mats; 2.) in ponds dominated throughout by Carex vesicaria and/or Equisetum fluviatile, H. aquatilis was frequently observed to occupy openings among such vegetation. Similarly, in ponds with open water in the center, H. aquatilis was observed to be most dense in such areas. While the species was found to occur amongst the stems of other emergent plants, it was often not as abundant in such situations. These observations suggest that H. aquatilis may prefer more open microhabitats within the ponds it occupies, and that it cannot compete vigorously with other aquatic plant species.

H. LAND OWNERSHIP (MONTANA)

1. The land ownership for the 52 populations known in Montana is given below. The site names are given, followed by the population occurrence numbers. The exact locations are provided in Table 1, pp. 5-15.
 - a. U.S. Forest Service (Flathead National Forest):
 - Condon Creek (006, 020-027)
 - Dog Creek (018, 019)
 - Lindbergh Lake (001, 043-048, 051)
 - Lost Creek-Cilly Creek Ponds (008-017)
 - Swan River West (007)
 - b. U.S. Forest Service (Flathead National Forest) and private land:
 - Lindbergh Lake (036)
 - Swan River Oxbow (005; most of the occurrence

is on land recently purchased by The Nature Conservancy)

c. Burlington Northern land:

Condon Creek (028-031)

Lindbergh Lake (002, 037-040)

d. Private land holdings:

Kraft Creek (052)

Lindbergh Lake (003, 004, 032-035, 041, 042, 049, 050)

II. ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

- A. THREATS TO CURRENTLY KNOWN POPULATIONS (MONTANA): The current threats to populations of H. aquatilis in Montana are mainly from timber harvest activities occurring adjacent to the pothole ponds which the species occupies. Additionally, some populations are adjacent to gravel logging and public access roads, and are thus susceptible to any road improvement activities which may take place. Lastly, in the vicinity of Lindbergh Lake, some ponds are currently disturbed or potentially threatened by domestic livestock grazing. The sites threatened by these activities are reviewed below:

1. TIMBER HARVEST ACTIVITIES: Of the 52 populations of H. aquatilis found in the Swan Valley, 21 occur in ponds around which logging has occurred historically or in the very recent past. In many cases, all coniferous trees were removed down to the pond margins, and the trees left standing were broadleaf deciduous species (i.e., Populus tremuloides, P. trichocarpa). In a few instances, no trees were left bordering some sides of the ponds, and in one case (Lindbergh Lake (001)), logging slash had been placed in the water.

Listed below, by site name and occurrence number, are the 21 pond habitats whose margins or immediate surroundings have been physically impacted by timber harvesting. Those which have been very recently impacted (i.e., in 1986-87) are indicated by an asterisk (*).

Condon Creek:

*025

*027

*029
 *030
 031

Dog Creek:

018

Lindbergh Lake:

*001
 002
 *037
 *038
 *039
 046
 047
 048

Lost Creek-Cilly Creek Ponds

009-015 (seven ponds)

The following populations are located in areas where nearby forests have been logged. Though the habitat immediately surrounding these ponds may still be intact, they are considered vulnerable to further future logging activity.

Condon Creek (006, 020, 021, 022, 023, 024, 026, 028)

Lindbergh Lake (045)

Swan River West (007)

One population occurs in an area which has not yet been logged, but in which new logging roads have recently been constructed:

Lindbergh Lake (051)

2. ROAD CONSTRUCTION AND MAINTENANCE: The following ponds supporting H. aquatilis occur alongside gravel logging and public access roads:

Kraft Creek (052)

Lindbergh Lake (004, 033, 036, 044, 049)

Lost Creek-Cilly Creek Ponds (016, 017)

3. GRAZING: Two ponds (Lindbergh Lake (041, 042)), located on private land, were found to be heavily

impacted by grazing of domestic livestock (esp. horses). Grazing and traversing of these sites has physically disturbed the associated shorelines and vegetation; these sites could also be influenced by changes in nutrient status from livestock bodily wastes. Both of these populations were small: four plants (041), and 50-60 plants (042).

Much of the area near Lindbergh Lake is used for open cattle range, especially south of the Swan River. Three populations in this vicinity, on Flathead National Forest land, are in areas currently being used for open range cattle grazing (Lindbergh Lake (046, 047, 048)). Impacts near these ponds were noted, and it is probable that they are used for watering by the livestock.

- B. MANAGEMENT PRACTICES AND RESPONSE: Despite the fact that H. aquatilis occurs over a large geographic area, it is ecologically restricted to a narrowly defined aquatic habitat. Thus, any direct impacts on its habitat are more likely to cause the extirpation of disturbed populations. The species is not one that appears to be capable of colonizing disturbed habitats.

The influence of habitat alteration around the ponds could have an effect on their successional trends. In cases where logging has occurred near the habitat margins, an increase in siltation rate into the ponds would be expected. Such a change would probably influence both the nature of the bottom substrates and the vegetational composition of the sites. As discussed above (I.E.3.a.), H. aquatilis occurs most frequently and most densely in ponds with firm, consolidated organic clay bottom sediments. It also is frequently found in more open areas within the ponds. Thus, increases in bottom sedimentation, and subsequent competition from other vegetation, could both have an adverse effect on the viability of H. aquatilis populations.

Impacts from grazing could also potentially influence the vegetation composition of the ponds, through increased nutrient levels and subsequent successional changes. Also, trampling of the bottom sediments may adversely affect the seed bank, and the consolidated substrate which appears to be necessary for vigorous germination.

- C. RECOMMENDATIONS FOR MAINTAINING VIABLE POPULATIONS: In order to insure the long-term persistence of viable populations of H. aquatilis on U.S. Forest Service

lands in Montana, the following recommendations are made:

1. Protection of habitats which currently support populations. Twenty-nine populations of H. aquatilis have been found on U.S. Forest Service lands. Of these, timber harvesting has occurred around 14 of them:

Condon Creek (025, 027)

Dog Creek (018)

Lindbergh Lake (001, 046, 047, 048)

Lost Creek-Cilly Creek Ponds (009-015)

The remaining 15 populations occur in relatively intact forest communities:

Condon Creek (006, 020-024, 026)

Dog Creek (019)

Lindbergh Lake (043-045)

Lost Creek-Cilly Creek Ponds (008, 016, 017)

Swan River West (007)

All of these populations should be considered in future land use management plans, i.e., road construction, future timber harvesting, grazing allotments, etc. In addition, since the long-term influences of disturbance adjacent to the ponds are unknown, it is especially important that the undisturbed populations be maintained in their current condition.

2. Notification of U.S. Forest Service personnel of locations of populations on U.S.F.S. lands. To prevent inadvertent impacts to known populations, all appropriate Flathead National Forest personnel should be provided with detailed location information. It is especially important that Ranger District timber sale managers, engineers, and other planners know the precise locations, so that disturbance may be prevented.
3. Evaluation of projects which may affect the hydrology of habitats supporting populations. Because the ponds supporting H. aquatilis populations depend largely on run-off for water supply, impacts which may influence this source

should be carefully studied. Also, projects which could result in permanent inundation or drying of the ponds should be mitigated. The hydrology of the Swan Valley is highly complex, and H. aquatilis is dependent upon intact drainage patterns.

D. RECOMMENDATIONS FOR FURTHER ASSESSMENT

1. Further surveys in potential habitats in the Swan Valley. Areas which could possibly support additional populations of H. aquatilis include ponds and wetlands in the vicinity of Glacier Creek, adjacent to the Elk Creek, Kraft Creek, and Windfall Creek drainages (USGS Cygnet Lake and Hemlock Lake 7.5' topographic maps).
2. Establishment of monitoring studies on U.S. Forest Service lands. Owing to the sensitivity of the populations and their habitat, plot studies to determine trends could potentially be quite damaging. However, yearly monitoring studies, to assess general population trends, should be initiated. The most critical populations to be studied in this regard are those 14 in areas disturbed by timber harvesting, discussed in Section II.C.1., p. 37. Such yearly population checks will hopefully provide some indication of the effects of this land use on the sites.

- E. SUMMARY: Howellia aquatilis is a monotypic genus with extant populations in Washington and Montana, and historical occurrences in Idaho, Oregon, and California. A total of ten sites are currently known rangewide, many of these consisting of numerous small, adjacent populations. It is a Category 2 candidate species, being considered for listing under the federal Endangered Species Act of 1973 by the U.S. Fish and Wildlife Service. In addition, it is currently a proposed sensitive species in Region 1 of the U.S. Forest Service. Recent studies indicate that the species has no genetic variation within or among populations. Ecological studies reveal that H. aquatilis is strictly confined to a narrow habitat type (vernal ponds and sloughs which dry by late summer). These two factors make the species especially vulnerable to habitat alteration or loss. Future land use activities in the vicinity of known populations should be planned with consideration for maintaining them, in order to insure that listing of Howellia aquatilis under the federal Endangered Species Act does not become necessary.

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IV. ELEMENT OCCURRENCE PRINT-OUTS AND MAPS (PP. 42-112)

V. PHOTOGRAPHS (PP. 114-120)